# LIFE SWSS

## "Smart Water Supply System"

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# Executive Summary

This report describes the assessment of the socio-economic impact of LIFE SWSS project actions. The report identifies the main benefits that the project has brought to the water utilities involved, as well as for the water consumers, the environment and the stakeholders. It describes the most relevant achievements regarding water losses reduction and energy efficiency improvements.

# 1 – Introduction

This report describes the analysis of the socio-economic impact of the LIFE SWSS project actions.

The report is organized in four main parts. In the first section, the most relevant impacted parties are identified, namely, the water utilities, the water consumers, the environment and other stakeholders. In the second and third parts, the most relevant impacts of the project are identified and quantified, whenever possible, regarding energy efficiency and water losses reduction. Finally, in the fourth part, the social and environmental benefits of the project are summarized and discussed.

# 2 – Socio-Economic impacts

The socio-economic impacts from reducing water losses and energy consumption in water supply systems are diverse and occur at several levels. Water utilities directly benefit from reducing Operation and Maintenance (O&M) costs associated with the reduction of water losses and with the improvement of the efficiency of pumping stations. Additionally, other entities also indirectly benefit from the project. In this chapter, the socio-economic impacts and benefited parties are identified.

## 2.1 Water utilities

LIFE SWSS project had a significant impact in the water utilities managing the demonstration cases. Although the SWSS platform has only started to fully operate in 2018 and the economic benefits can hardly be quantified, the project brought the energy efficiency and water losses reduction to the table. Hence, the utilities became more aware of these subjects and, simultaneously with LIFE SWSS, EPAL and AdA invested in many measures for reducing water losses, energy consumption and associated costs. EPAL made use of the results of LIFE SWSS B1 action and undertook an exhaustive pump refurbishment plan that improved the pumping stations performance and reduced energy consumption and costs. AdA invested in renewable energies, mostly by installing photovoltaic panels in water treatment plants, thus reducing energy consumption from the national electrical grid, generated by non-renewable sources. Both utilities are making efforts to quickly identify and repair pipe leaks for water losses reduction. On the overall, the project enabled the utilities to become more efficient, i.e., to provide the same service at a better level and with less associated costs.

However, the benefit for water utilities goes beyond the direct quantifiable benefits. By making use of less natural resources to provide a service for its clients, the utilities also improved the utilities' image, thus gaining in consumers' confidence and engagement. During the project period, both Águas do Algarve and EPAL strongly invested both in educational programmes, raising awareness for the need of using water wisely and reducing waste.

## 2.2 Water consumers

Water utilities provide an essential service for the population that is on the basis of society's well-being and prosperity. Energy efficiency improvement and water losses reduction in the water utilities have an impact on their own operational costs which then impacts on the water tariffs. Hence, lower costs for the utilities have the potential to decrease water tariffs, thus benefiting the water consumers.

In Portugal, the water tariffs are yearly determined by ERSAR, the regulator authority for water and waste services, and tariffs are a function of the operational costs of water companies, along with other costs. Water supply tariffs must respect the principle of full cost recovery, i.e., water charges should not be lower than the direct and indirect costs of the supply service [1]. The water price fixing process, which also takes into account the inflation rate growth, is quite complex. Hence, although the water companies have improved their water and energy performance, there was no immediate and direct change on the water tariffs (Table 1). It must be noted that the presented tariffs are not the final price for customers, but the selling price to the utilities that manage the downstream distribution systems. Hence, the water tariffs of the final consumers also include the operational costs of other water utilities.

The change in Águas de Portugal companies in 2015 impacted the water tariffs of EPAL demonstration cases. For West and Centre systems, now part of the Águas do Vale do Tejo and managed by EPAL, annual water tariffs must be established in accordance with legislation regarding uniformity between EPAL tariffs and the former water tariffs [2].

The benefit for the population regarding direct water tariffs is likely to be observed only on the long run.

Table 1. Water tariffs of the water utilities during the project.

| Water tariff (€/m³) | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|
| AdA | 0.471 | 0.471 | 0.471 | 0.471 |
| AdVT (EPAL) | 0.618 | 0.455 | 0.522 | 0.537 |

In Portugal mainland, the annual expenditure on water supply per household is of about 214 euros (excluding sanitation services) according to the INE, the national statistics institute (Table 2). When compared with the total average expenditure per household, the weight of the water bill is of only 1.0%. In the demonstration cases of AdA (Algarve) and EPAL (Centre), the weight of the water bill is only slightly higher and of 1.1 and 1.2% respectively.

Therefore, the impact of energy efficiency and water losses reduction measures in the water utilities is likely to have very low impact on the budget of the families living in the regions supplied by the demonstration cases' systems.

Table 2. Annual expenditure on water supply per household [2].

| | Portugal | Mainland Portugal | North | Centre | Lisbon Metropolitan Area | Alentejo | Algarve | Azores | Madeira |
|---|---|---|---|---|---|---|---|---|---|
| Annual expenditure on water supply per household (€) | 212 | 214 | 208 | 226 | 220 | 174 | 233 | 199 | 154 |
| Total annual average expenditure per household (€) | 20 363 | 20 490 | 19 928 | 18 875 | 23 148 | 17 798 | 20 459 | 16 856 | 18 204 |
| Weight of the water bill on the average expenditure per household (%) | 1.0 | 1.0 | 1.0 | 1.2 | 1.0 | 1.0 | 1.1 | 1.2 | 0.8 |

## 2.3 Environment

Water losses and energy consumption reduction in water services are undoubtedly beneficial for the environment, due to the reduction of exploitation of natural resources. In Portugal, as in most of southern Europe, current climate conditions include frequent and severe droughts for which it is of paramount importance to efficiently use the available water. The water losses reduction, and the consequent

minimization of water abstraction from natural reservoirs and from groundwater sources, is crucial for preserving local ecosystems, as most of the rivers and dams are at very low levels.

On the other hand, the reduction of energy consumption, particularly of electrical energy produced from non-renewable sources has also an impact on the reduction of GHG emissions. The increased use of renewable sources of energy, such as solar energy, for water treatment and supply had a positive impact on the local environment as well.

## 2.4 Stakeholders

Many of the water and energy efficiency measures implemented by the water utilities during the project period required contracting additional services, either for infrastructure repair or new equipment acquisition (e.g., replacement of old inefficient pumps). These actions had a direct impact on the stakeholders, in particular, services and product suppliers, and increased their sales turnover.

LIFE SWSS brought attention to the water and energy efficiency subject that spread inside the water utilities participating in the project as well as in the Portuguese water industry, in particular, in the AdP group. EPAL will launch, in November 2019, an Advanced Programme in Renewable Energies in the Water Sector[1], with one particular module for improvement of energy efficiency and recovering the hydraulic energy available in the water supply and distribution systems.

The many dissemination activities carried out by the LIFE SWSS project consortium have raised awareness for the water-energy nexus and resources efficiency subject throughout the water industry stakeholders. In addition to the severe droughts in the last years, the project is partially on the basis of the many actions regarding public awareness for water saving that are being carried out by the utilities. In particular, many educational programmes for children are in place, promoting the efficient use of water and energy, as well as waste reduction.

[1] https://www.epal.pt/EPAL/menu/produtos-e-servi%C3%A7os/academia-das-%C3%A1guas-livres/energias-renov%C3%A1veis-no-setor-da-%C3%A1gua

# 3 – Impacts on energy consumption

## 3.1 EPAL demonstration cases

In addition to the platform implementation and operation optimization, EPAL systems' managers became have significantly increased their awareness of the need of reducing energy consumption, associated GHG emissions and costs. In the last three years, the energy consumed in pumping stations is more than 80% of the total energy consumed (Figure 1), for which the utility has been investing in energy efficiency of the pumping stations, in particular in the ones that are part of the demonstration cases.

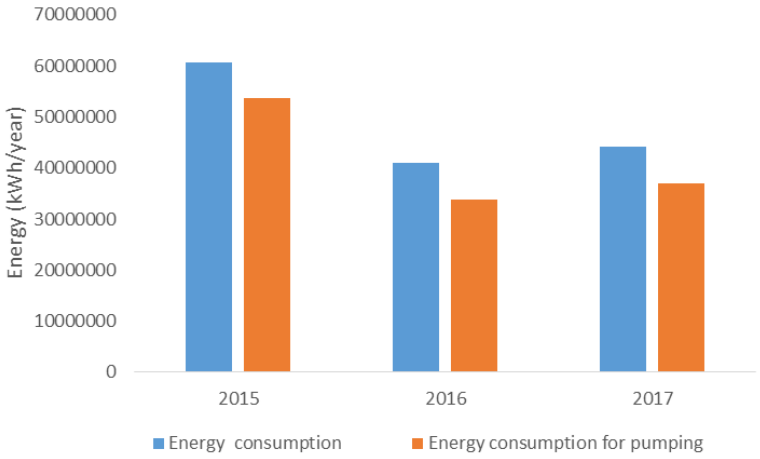


Figure 1. Annual global energy consumption and annual energy consumed for pumping in EPAL [4,5,6].

### 3.1.1 West demonstration case

The West demonstration case includes several pumping stations and was audited in terms of the energy efficiency in the initial survey carried out at SWSS (Action B1). The Alenquer IV Pumping station was one pumping station with interventions during the project, in 2016, although the others have also been carried out in 2018 and 2019, but results are not yet available. Also other interventions are programmed in the near future.

The energy auditing of the Alenquer IV Pumping station has shown that the overall efficiency of the station was 68.7%, which is 10% lower than the initial value set by the

pump supplier, of 77%. The need for improving the efficiency became evident and the utility decided to examine each pump in detail at the laboratory and to refurbish all the necessary components. Refurbishment costs were of about 14 100 € per pump.

Since 2017, Alenquer pumping station is much more efficient and EPAL was able to reduce both energy consumption and costs (Table 3): energy consumption reduced by more than 400,000 kWh/year and costs reduced by more than 40,000 €/year in only one pumping station.

Table 3. Energy consumed at Alenquer IV pumping station in the project period and associated costs

| Year | Energy consumption (kWh) | Water Supplied (m3) | Energy Costs (€) | Estimated Energy consumption* (kWh) | Estimated Energy Costs* (€) | Cost Reduction (€) |
|---|---|---|---|---|---|---|
| 2016 | 5 416 668 | 7 891 759 | 493 196 | - | - | - |
| 2017 | 5 552 350 | 8 353 649 | 469 940 | 5 733 696 | 485 288 | 15 349 |
| 2018 | 5 619 692 | 8 866 938 | 526 834 | 6 086 002 | 570 550 | 43 716 |
| 2019 (first semester) | 2 759 017 | 4 342 160 | 250 725 | 2 980 329 | 270 837 | 20 112 |

* Estimated as if no interventions were made in pumps, i.e, assuming pumps efficiency would be the same as in 2016

### 3.1.2 Centre demonstration case

Carvalhos Pumping Station pumping station, belonging to the Centre demonstration case, was also audited in the initial survey (action B1). The results have shown that the efficiency of the three existing pumps were in the range of 55% to 66%, while the original value set by the pump supplier was of 82%. Each pump was taken to EPAL laboratory, examined and refurbished. Refurbishment costs were of 6,500 € per pump. After repairing the three pumps, the pumping station's efficiency reached the original

value of 82%. This allowed for a reduction in energy consumption from 1.94 to 1.68 GWh/year. Thus, the energy savings in this pumping station are of about 315,623 kWh/year and the costs reduction is about 31,500 €/year.

## 3.2 Águas do Algarve

Águas do Algarve invested in a set of energy efficiency measures in addition to SWSS platform implementation. It included pumps' refurbishment, changes in the operating point of the pumps (for the best efficiency ones), changes in the pump scheduling for reducing costs and the increase of energy production from renewable sources, mostly from the sun.

Energy costs in AdA represented more than 30% of the overall operational costs before the beginning of Life SWSS project. As a result of the project implementation, in addition to a set of other measures for improving energy efficiency in the utility, the energy costs have decreased in AdA over the time period of the project from 33% to 26% of the overall operational costs (Table 4).

Table 4. Costs breakdown at AdA (not available data for 2018)

| | **2014** | **2015** | **2016** | **2017** |
|---|---|---|---|---|
| Reagents | 18% | 17% | 14% | 18% |
| **Energy** | **33%** | **33%** | **33%** | **26%** |
| Sludge | 1% | 1% | 1% | 1% |
| Analytical control | 9% | 9% | 8% | 3% |
| Cleaning and disinfection | 2% | 2% | 1% | 1% |
| Outsourcing | 22% | 25% | 30% | 36% |
| Other costs | 14% | 13% | 13% | 15% |

The energy costs reduction is a result of energy consumption decrease along with the increase in energy production. In 2018, AdA doubled the production of energy that increased from 617,248 kWh/year in 2015 to 1,275,077 kWh/year (Figure 2). Energy consumption in 2018 was 22,898,264 kWh, of which 17,374,977 kWh was consumed in pumping stations. These values are lower than the ones observed in 2017 but higher

than in 2015, when LIFE SWSS began, which is due to the increased water volumes supplied.

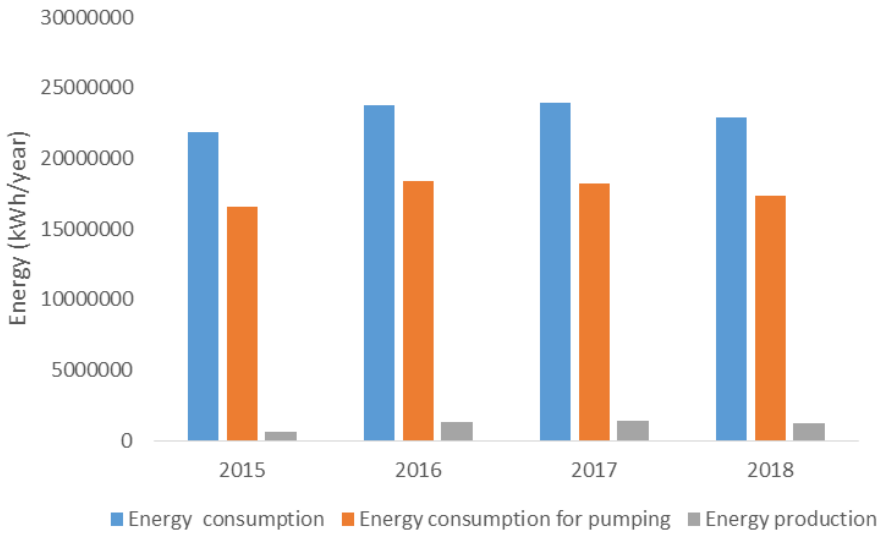


Figure 2. Annual global energy consumption, energy consumed for pumping and energy production in AdA [4,5,6,7].

# 4 – Impacts on water losses

Water losses in the utilities have started to decrease in the last years, demonstrating that the utilities are really making the effort to reduce water losses, by effective water loss control programs. According to the Portuguese water services regulator, the utilities demonstrate a good performance regarding water losses at a national level.

In AdA, real losses decreased from 688 655 $m^3$/year in 2015 to 665554 $m^3$/year in 2018, which corresponds to a 3% reduction in real water losses (Figure 3).

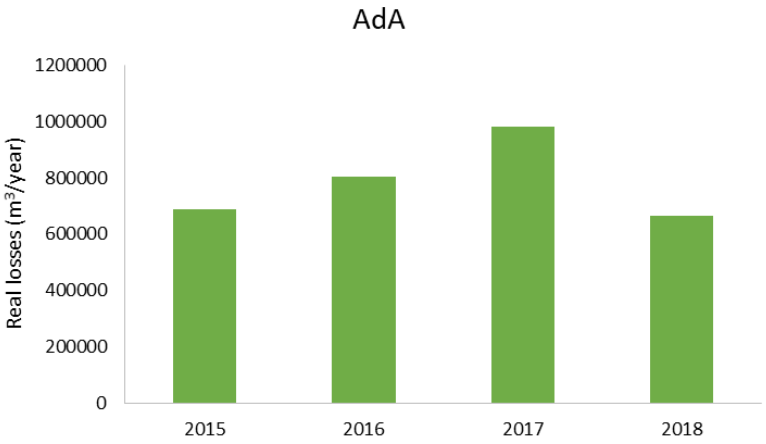


Figure 3. Annual water losses in AdA system [4,5,6,7]

For EPAL systems, the global real losses values seem to suggest an increase, however, this is due to the integration of other water supply system in EPAL (Figure 4).

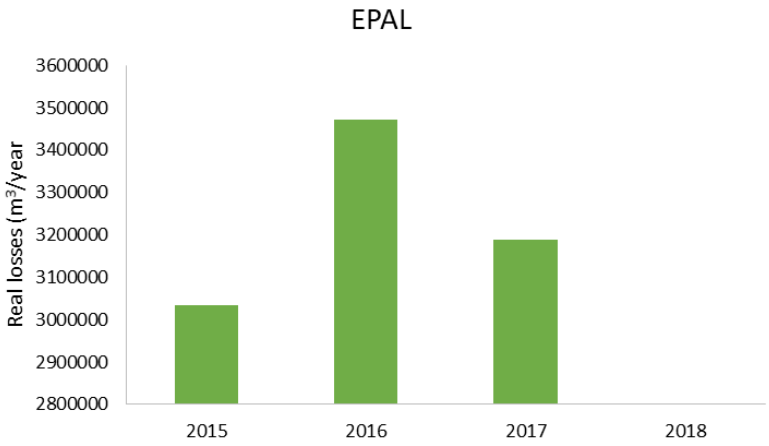


Figure 4. Annual water losses in EPAL systems [4,5,6] (not available data for 2018)

# 5 – Social impacts

All water losses reduction and energy efficiency measures that took place within LIFE SWSS and that effectively improved the utilities efficiency did not directly impact water consumers, at least the family expenses in water supply services. However, the utilities carried out many dissemination events, including workshops, as well as environmental education programmes that reached all consumers within the project implementation regions and beyond those areas (Figure 6 and Figure 5).

The social impact of an educated population, who is aware of the need for the efficient use of natural resources, as water and energy, is not easily quantifiable. In LIFE SWSS implementation regions, in particular in Algarve, where water scarcity is a reality, population knows the real value of water, especially children, and how to avoid unnecessary waste of this precious resource. Such educational programmes and events contributed for raising environmental awareness in the scope of water and energy that will remain in local societies for the years to come.

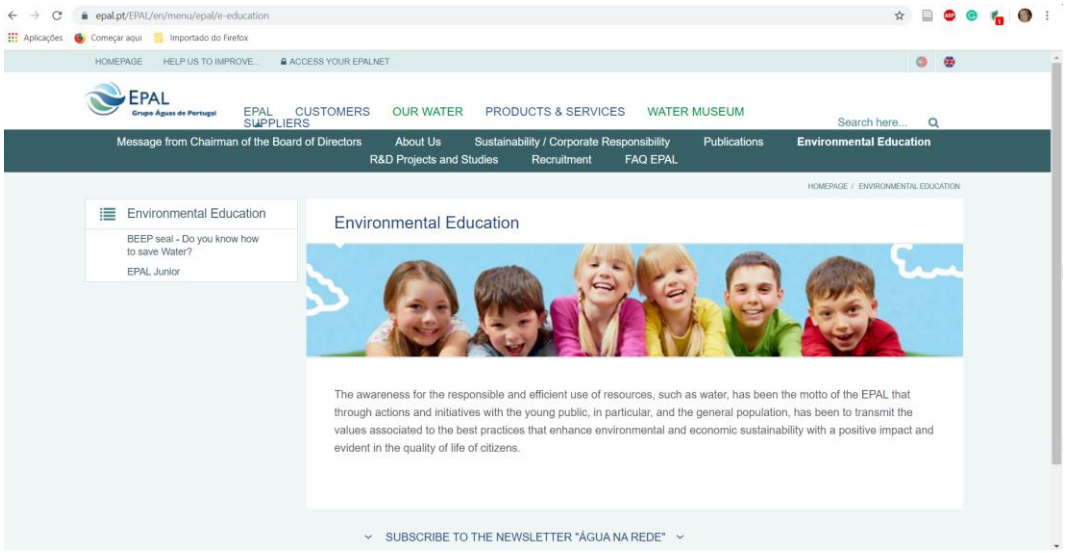


Figure 6. EPAL website

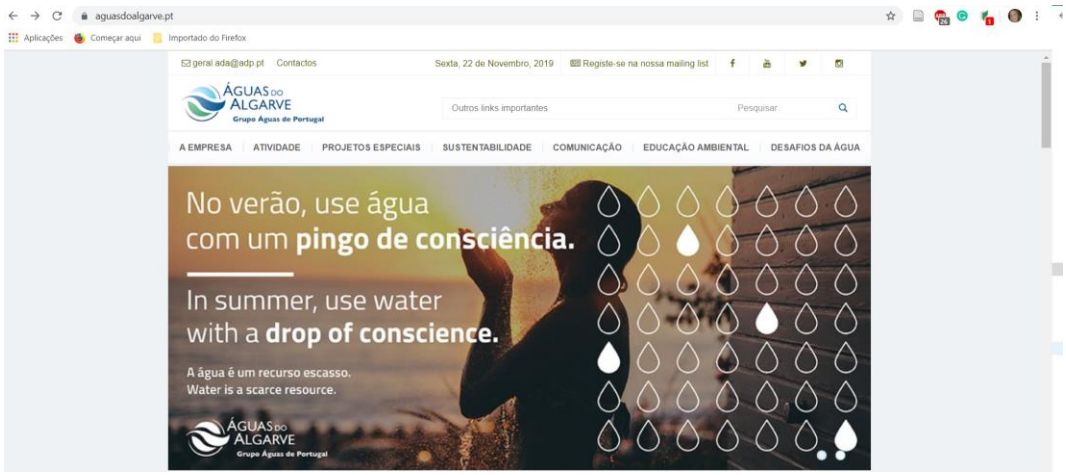


Figure 5. AdA website

# 6 – Final remarks

Energy and water have traditionally been considered independent resources, though the interdependence between these two fundamental resources is now globally accepted: water is required to produce, to transport and to use all forms of energy and energy is required for the abstraction, treatment, transport and distribution of water and wastewater. Improving energy efficiency and reducing water losses in the water services have become key concerns for the politicians, the water utility decision makers and the society.

The LIFE SWSS is a decision support platform aiming to facilitate the daily management of water supply system, incorporating several tools for the online system monitoring, the water and the energy balances calculation, the demanding prediction and the pumps schedule optimization.

The implementation of SWSS platform had a direct impact on the utilities of the AdP group that served as case studies – AdA and EPAL – since many pumping stations were identified as inefficient and refurbishment measures have been carried out or are programmed for the short term. These measures are easily and directly quantifiable in the reduction of the operational costs of these utilities, as demonstrated.

Additional, and above all, the disseminations activities carried out during the project in Portugal, such as workshops and seminars, have created awareness within the water sector community, which includes managers, operators and consultant engineers, for the importance of water losses reduction and energy efficiency improvement.

Nowadays, 4 years after the beginning of the LIFE SWSS project, many Portuguese water utilities have started to use decision support tools, such as SWSS, DECIDE or Baseform in the daily management of their systems, since they have realized the benefit that they take from it. These 3 platforms are all distinct. While DECIDE focuses on collecting different types of data (not real-time data as SWSS) and on reporting performance indicators that can be provided to the water services regulator on a yearly basis, Baseform platform provides a number of services, some very similar to the SWSS platform. However, the water and energy balances that are computed on SWSS platform based on SCADA data must be manually computed on Baseform. The user must introduce all the data (not real-time data), which is more difficult and prone to errors. The optimization module implemented in SWSS platform cannot be found elsewhere, which makes the platform unique and attractive for the utilities. AdA will continue using the SWSS platform after the project end and have expressed willingness to expand the implementation of the SWSS platform to its whole network. EPAL is not currently using the platform due to the persistent IT problems and the lack of real-time data. However, the utility intends to use the platform, once the real-time data is available, in particular the optimization module.

Besides the utilities, the consumers, the society and the environment all benefit from a better management of water and energy.

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